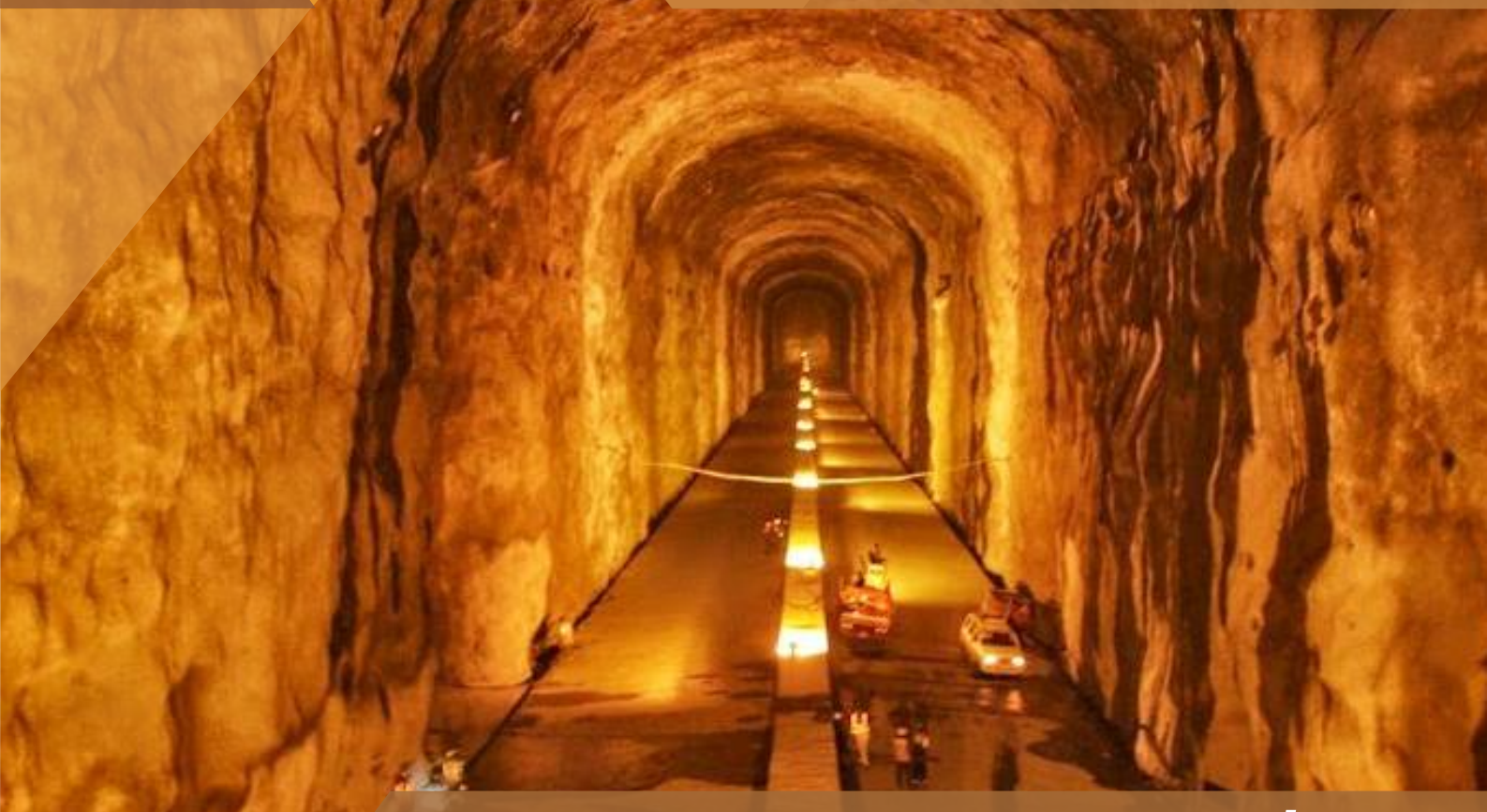
Engineers India Limited



Project Management Consultancy For Underground Storage Technology

PROFILE

Engineers India Ltd. (EIL) is a leading global engineering consultancy and EPC company. The Company has a diverse portfolio comprising Hydrocarbon, Chemicals & Fertilizers, Mining & Metallurgy, Infrastructure, Water and Waste Management, Solar & Nuclear Power sectors.

EIL has emerged as a 'Total Solutions' engineering consultancy company providing design, engineering, procurement, construction and integrated project management services from 'Concept to Commissioning' with highest quality and safety standards. It also provides specialist services such as heat and mass transfer equipment design, environmental engineering, specialist materials and maintenance and plant operations and safety services.

EIL has successfully completed all projects, all of which are operating smoothly (in most cases at more than rated capacity), and has, hence, created an array of satisfied clients. EIL has secured many repeat businesses from its clients which is a sign of client satisfaction, confidence and trust reposed in EIL.

Over the past five decades, EIL has executed more than 5000 projects including over 400 major projects worth USD 200 Billion in "total cost".

EIL has earned the reputation of being a veritable treasure of technical knowledge, skills and professional competence. EIL has worked with almost all process licensors and a large number of engineering/ contracting companies worldwide and our engineers are well versed with international engineering codes and standards. With a workforce of over 3000 experienced employees & a variety of specialised services available under one roof, EIL offers an unique advantage to clients like none other.

5.6 million available Technical Manhours annually
9,600 available Construction Management and Supervision Man-months annually

GLOBAL PRESENCE

Geographical Regions	Key Countries served
Middle East	UAE | Bahrain | Kuwait | Iran | Oman | Saudi Arabia | Qatar | Iraq
Asia / Asia Pacific	Australia | Malaysia | Indonesia | Bangladesh | Vietnam
Europe	Norway | Turkey
Africa	Algeria | Ghana | Kenya | Nigeria | Angola | Sudan | Cameroon

TRACK RECORD

- 72 Major Refinery projects, including 10 grass root refineries,
- 9 Petrochemical complexes,
- 41 Oil and Gas Processing projects,
- 213 Offshore platforms including 40 process platforms,
- 46 Pipeline projects,
- 13 Ports, Storage & Terminals,
- 9 Fertilizer projects,
- 32 Mining and Metallurgy projects,
- 33 Infrastructure projects (airports, highways, bridges, water management, & energy-efficient intelligent" buildings),
- 23 Turnkey/EPC projects.
- Infrastructure Projects
- Power / Captive Power Projects

EXPERIENCE CREDENTIALS & GLOBAL PRESENCE

Overseas Clients

MIDDLE EAST	ADNOC, ADMA OPCO, GASCO, TAKREER, ADCO, ZADCO, BOROUGE, BUNDUQ, NPCC, ADGAS, BANAGAS, BAPCO, ALBA, KNPC, EQUATE, PIC, NPC, ORPIC, SAUDI ARAMCO, SABIC
ASIA	PETRONAS, WIKA, PAU, TPAO, BCIC
AFRICA	SONATRACH, BOST, KPRL, DANGOTE, INDORAMA, SONANGOL, SUDAPET, WNPOC, HYDROMINE GLOBAL MINERALS GMBH Ltd.

INDIA

INTERNATIONAL

Energy Security Mandate

Oil consuming Indian economy is increasingly vulnerable to oil and gas supply disruptions, necessitating emergency preparedness and response measures.

With about 80% of the demand of India being met through import of crude oil, strategic inventory of crude oil in large underground storage installations forms a key imperative.

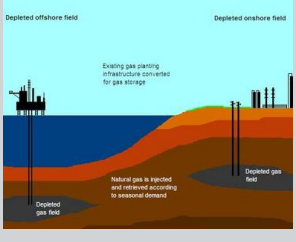
In addition to the long term interventions; the short-term measure that offers immediate resilience to supply disruption of crude oil is the **"Strategic Petroleum Reserves (SPRs)".**

Underground Storage Alternatives for Hydrocarbons

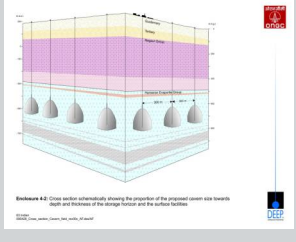
Advantages of underground storages include:

- Product storage is located at a depth and is fully isolated
- Principle of containment ensures no leakage and contamination
- Safest and environment friendly means of storage
- Safety hazards viz. sabotage, earthquakes, explosions are minimized
- External fires do not affect storage inventory
- Surface land requirement is low compared to conventional above ground (A/G) Storage
- Economical for a large storage capacity of about 1.0 MMT
- Design life of U/G storage is longer than A/G storage relatively
- Construction cost & operating cost is lesser than A/G storage

In general, four underground storage concepts are in use:

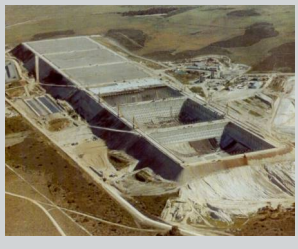


Depleted Reservoirs & Deep Aquifers



Solution Mined Salt Caverns

Underground Rock Caverns



Underground Concrete Tanks

Phase I & II Storage Program of Government of india

Strategic Petroleum Reserves (SPRs) under Phase I storage program of Government of India is being implemented by M/s Indian Strategic Petroleum Reserves Ltd. (ISPRL) under the aegis of Ministry of Petroleum & Natural Gas (MoP&NG) and is being executed by Engineers India Ltd. (EIL) as the Project Management Consultants at the following three sites:

Location (India)	Storage Technology	Capacity
Vishakhapatnam	Underground Unlined Rock Caverns	1.33 MMT
Mangalore	Underground Unlined Rock Caverns	1.50 MMT
Padur (Udupi)	Underground Unlined Rock Caverns	2.50 MMT

Site Selection Criteria & Design Manifests	
Storage requirements;	Product loading & unloading facilities;
Safety and environment conditions;	Geological setting of the site;
Subsurface rock mass quality;	Hydro-geological regime of the site;

Unlined rock caverns entail "hydro-geological containment" principle wherein surrounding rock mass saturated with ground water supplemented by a water curtain system exerts a positive hydrostatic pressure on the caverns and prevents migration of crude oil and vapour through fissures that would naturally be present in the rock mass.

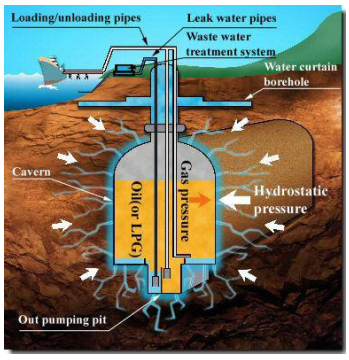
Principle of underground oil storage

- Oil is lighter than water &
- Oil is insoluble in water

A higher hydrostatic pressure prevents gas leakage and oil migration

Gas Tightness Control Methods include

- Permeability controlling by grouting
- Hydrodynamic containment by water curtain system



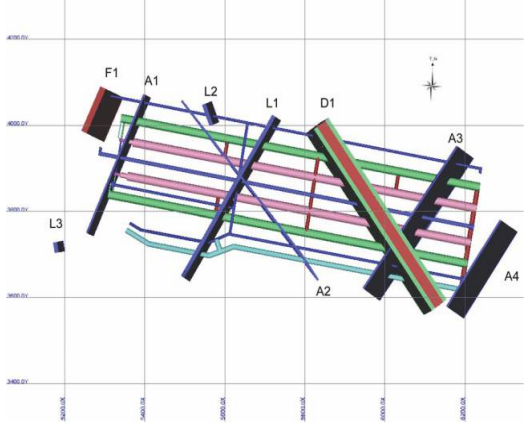
EIL has carried out the Detailed Feasibility Study and prepared the DPRs for the Phase- II storage program of Government of India at the following four locations:

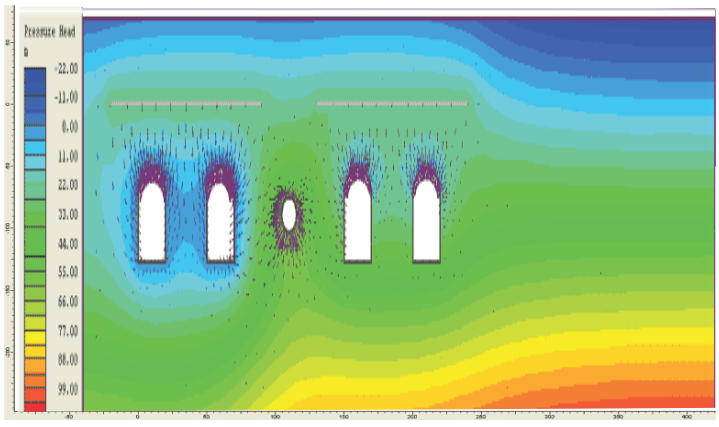
Location	Storage Technology	Capacity
Padur	Underground Unlined Rock Caverns	2.50 MMT
Rajkot	Underground Concrete Tanks	2.50 MMT
Bikaner	Solution Mined Salt Caverns	3.75 MMT
Chandikhol	Underground Unlined Rock Caverns	3.75 MMT

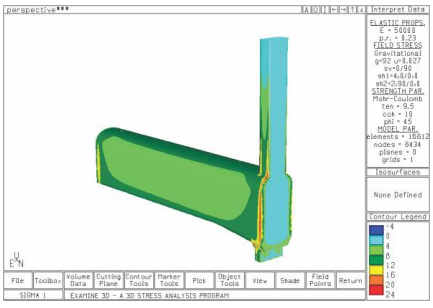
EIL's Domain Expertise and Capabilities

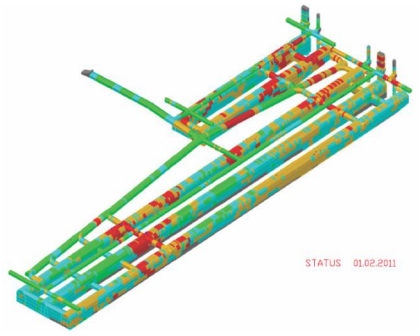
A first of it's kind of projects in India, EIL have developed domain expertise in the following areas of underground storage space utilization:

- Feasibility Studies & Detailed Project Reports
- Exploratory Investigation Campaigns
- Geology, Hydrogeology & Rock Engineering Aspects
- Above Ground Process Facilities
- Cavern Integrity Testing and Commissioning
- Construction Management









EIL has a pool of qualified domain experts in the areas of geology, rock engineering, hydrogeology, construction, process and overall civil and mechanical works to execute such large complex projects involving the subsurface uncertainties.

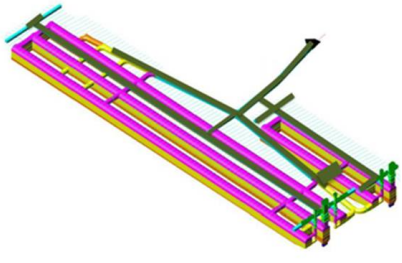
Major Accomplishments

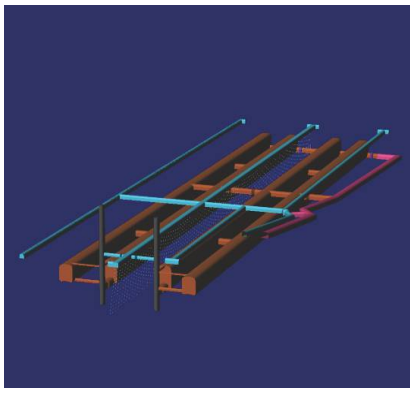
- Absorption of underground rock cavern storage technology
- First underground crude oil storage of India at Vishakhapatnam Commissioned.
- Largest successfully completed underground construction project of India at Padur (Udupi), Karnataka.
- 15 Million Loss Time Accident (LTA) free man-hours achieved at Padur Storage Project

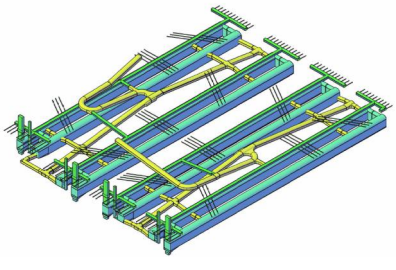
Future strategy

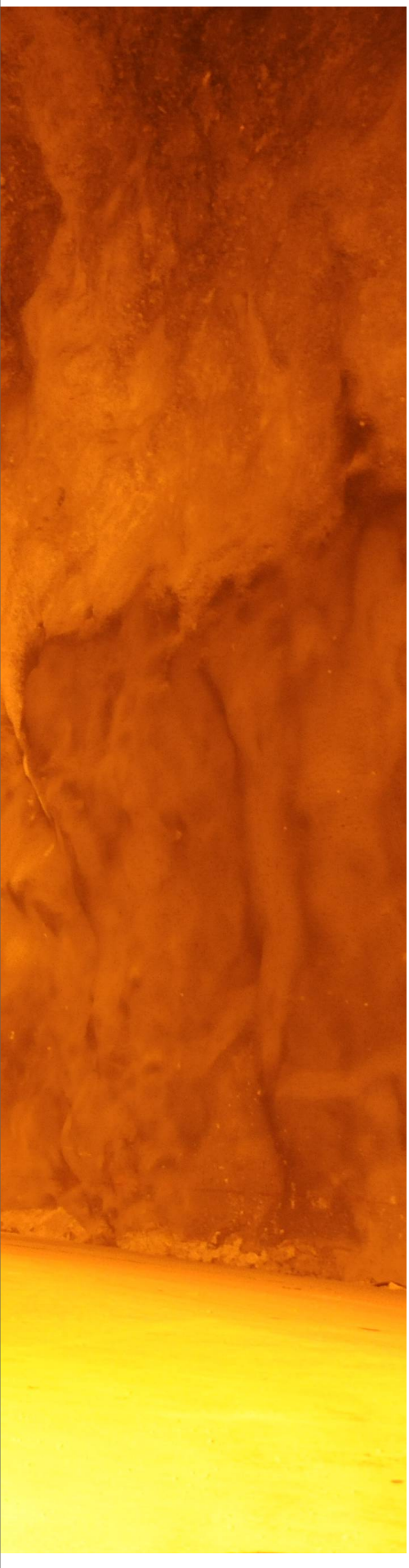
- Contribute towards underground space utilization for strategic projects.
- Readiness for execution of Phase II storage program of Govt. of India.

A Bird's Eye View of the Commissioned Crude Oil Storage Facilities at Vishakhapatnam









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Delivering Excellence through People

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